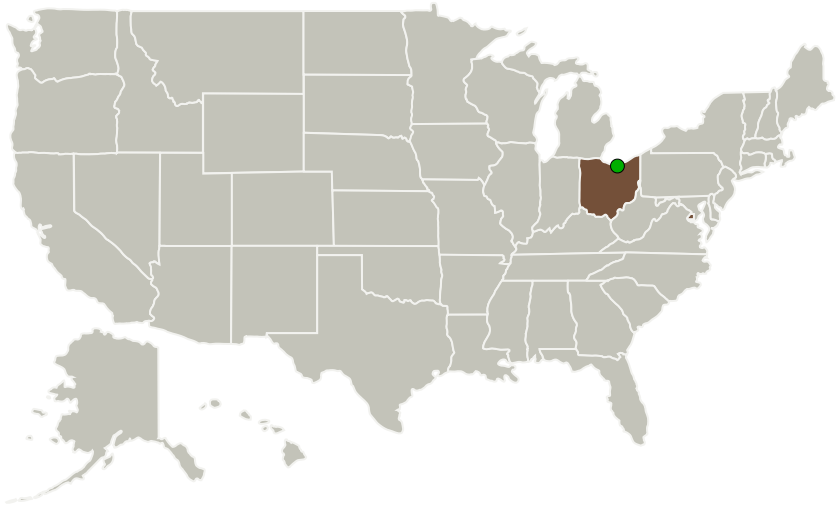
Ultrasonic Additive Manufacturing for High Performance Combustion Chambers, Phase I

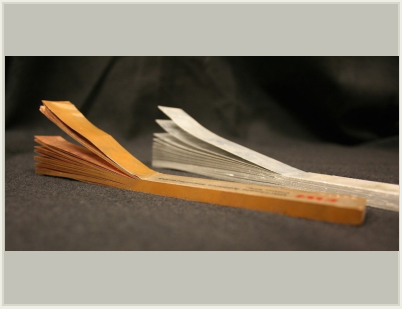
Completed Technology Project (2016 - 2016)

Project Introduction

The objective of this proposal is to demonstrate the feasibility of using ultrasonic additive manufacturing (UAM) to dramatically reduce the cost and lead-time of fabricating rocket engine chambers, particularly high performance rocket engine chambers. Rocket engine combustion chambers require a very complex geometry, consisting of a cylinder of varying diameter, with a variable wall thickness, and integral complex coolant passages in the wall These chambers must be capable of withstanding high internal chamber pressure and high pressure fluid within the passages without suffering mechanical failure from hoop stress or coolant passage blowout, while also undergoing intense thermal stress from the extreme heat transfer levels. Levels of fit and finish are very high to minimize turbulence both in the combustion chamber and the coolant passages. The inner walls of the chamber must be extremely thin, and are held to very exacting tolerances, yet are usually machined into the outside of a chamber. The large number of discrete operations, high tolerances, multiple materials, and most often distinct vendors for each step lead to very high cost and long manufacturing lead times for these components. If a bimetallic UAM printing process can be demonstrated successfully, the cost of combustion chamber fabrication could drop by 10-100X and significant time and cost can be saved from engine development programs. This would be in line with the goals of NASA's Low Cost Upper Stage Propulsion initiative, which is aimed at reducing costs by 50%. A significant win in chamber manufacturing costs will dramatically advance the program goals. TGV will build upon this technology to produce the system capability to launch 100 Lbs. to LEO for $1 Million.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
TGV Rockets, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Washington, District of Columbia
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
District of Columbia	Ohio

Project Transitions

July 2016: Project Start

December 2016: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139599)*

Images

Briefing Chart Image
Ultrasonic Additive Manufacturing for High Performance Combustion Chambers, Phase I
(https://techport.nasa.gov/image/131199)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
TGV Rockets, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

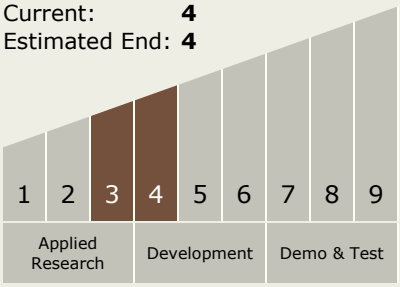
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Earl W Renaud

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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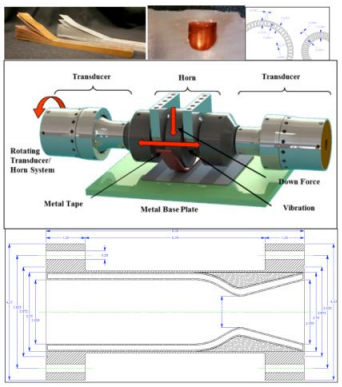

Final Summary Chart Image
Ultrasonic Additive Manufacturing for High Performance Combustion Chambers, Phase I Project Image *(https://techport.nasa.gov/image/136874)*

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System